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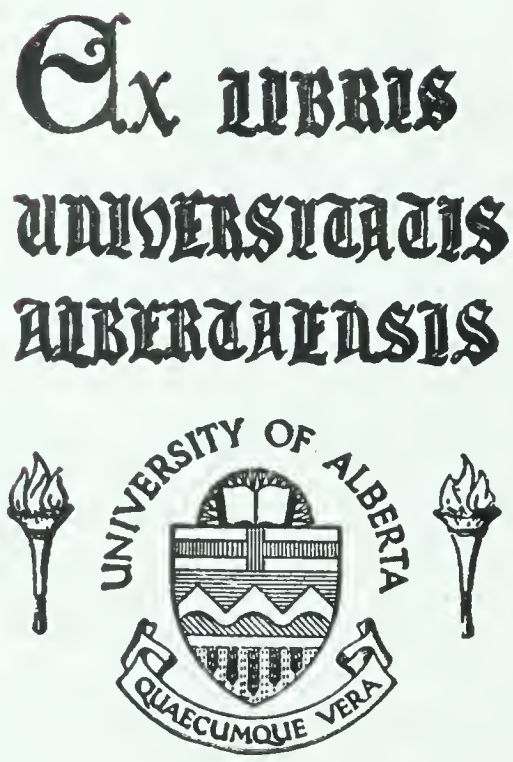

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SOCIO-ECONOMIC STATUS AND THE DEVELOPMENT OF INTELLIGENCE

by

ARTHUR JOHN CROPLEY

A THESIS
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UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Socio-Economic Status and the Development of Intelligence" submitted by Arthur John Cropley in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

The purpose of this study was to ascertain the effect of socio-economic status on the intelligence of a sample of Edmonton school-children, and to show the longitudinal relationship between the patterns of intellectual functioning at two age levels.

The model of intelligence employed was the statistically derived, hierarchical model, and the instrument used was the Wechsler Intelligence Scale for Children. The sample consisted of 70 Edmonton Public School Board children, aged ten years at the first testing in 1961, and twelve years at the second testing in May, 1963. These children were randomly chosen from the complete enrollment of Public School Board children born in the months of June, July and August, 1950.

The socio-economic status of the sample was determined by the use of a battery of socio-economic status measures based on various combinations of parental occupation, parental education and 'general goodness' of the home background.

The major findings of the study were:

1. The children who scored high on the measures of socio-economic status achieved significantly higher means on the Wechsler Intelligence Scale for Children sub-tests which depend on verbal skills, but not on those sub-tests dependent on performance skills.

2. Factor analysis of the sub-test scores indicated that the children comprising the sample made great use of general intelligence at both age levels, and that dependence on general intelligence tended to

increase over the two-year period involved in the study.

3. A single factor accounted for almost all of the covariance between the two batteries of sub-tests. There were no common specifics.

No tendency was apparent in the data for the effect of socio-economic status on intelligence to disappear with the passage of the two years between testings. In fact, there were some indications suggesting that its effect had increased. This was true of the verbal sub-tests in particular.

The absence of specific factors common to both administrations of the WISC was interpreted as indicating that the scale is largely measuring different skills at the two age levels involved in this study. Furthermore, on the basis of the factorial pattern of the sample's responses, it was concluded that the WISC had measured two main dimensions of their intellectual functioning. The first of these dimensions was predominantly verbal in nature, and the second was chiefly defined by the performance sub-tests of the scale.

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CHAPTER I

INTRODUCTION

Intelligence tests are now a common part of the psychological armament, and scores they yield are frequently used to make statements, essentially predictive in nature, about a child's potential. These statements are made despite the continuing lack of agreement of exactly what intelligence is, or of what experiential factors affect its level and its rate of development.

Furthermore, test interpretation may well be limited by an imperfect understanding of what factors in an individual's score are a reflection of his experience and environment rather than his innate potential, best understood as a concept like Hebb's Intelligence A. (Hebb, 1958).

Few would deny that our society is divided into social sub-groups; further, there is a good deal of evidence to indicate that there are typical and characteristic differences in the kinds and degrees of skills possessed by the various socio-economic sub-groups within the society. Consequently, the possibility arises that these class differences may be reflected in scores obtained on intelligence measures, as certain segments of the society are confronted with tasks requiring skills in which they have particular facility or impoverishment, as a result of their social experiences, thus producing scores which are systematically and characteristically biased. If this is the case, interpretations of test profiles, especially when they are used to make predictive statements, will

have social factors to take into account as well as scaled sub-test scores.

Furthermore, when an intelligence scale is used to make statements which predict future functioning on the basis of present performance, the statements pre-suppose a stable relationship between present and future performance. However, there is some disagreement as to how the passage of time affects the functioning of intelligence; the individual's relationship to his environment is certainly a dynamic thing, and it is likely that the environmental effects on his intellectual functioning change with increasing age. The pattern of a child's intelligence, far from being irrevocably established, may well be an aspect of him which undergoes change, and the pattern of that change is likely to vary with his social background.

Various studies have shown that characteristic achievement patterns exist for children of differing socio-economic status, and that the nature of these patterns is subject to change with maturation. In particular, the experiences in the school situation common to both high and low socio-economic status children, are likely to impose a trend towards homogeneity of intellectual functioning. On the other hand, both increasing age, and training in and out of school affect the specific skills available to children.

The problem posed by this line of thought is connected with the need for a better understanding of the relationship between social group membership and intelligence test scores, and the effect of maturation on the intellectual functioning of the child. The difficulty for the clinical psychologist lies in the interpretation of psychometric patterns. It is

possible that differences in test scores and profiles may arise from variations in the socio-economic status of the subjects and associated differences in their intellectual functioning, rather than from pathology.

The purpose of this thesis is to investigate these issues by an analysis of the scores obtained on the Wechsler Intelligence Scale for Children by a sample of Edmonton school children at the ages of ten and again at twelve, and by a comparison of the performance of high and low socio-economic groups within the sample. An attempt will be made to show where the differences between social groups lie, and to indicate, through a factorial study, the factors involved in intellectual functioning at ages ten and twelve.

CHAPTER II

RELATED RESEARCH

I. THE CONCEPT OF INTELLIGENCE

Any discussion of the structure of intelligence demands that some attempt be made to clarify the issue of just what intelligence is and how it develops with increasing maturity and experience. There is, even now, no absolute agreement as to what constitutes intelligence, especially among educators.

The Traditional View of Intelligence

Intelligence has no unique definition, and various theorists have considered it in terms of different approaches. The traditional approach was to think of it as a single whole, transmitted by hereditary endowment, and fixed in quantity and form. This point of view, inherent in much of present day educational practice, was held by Galton (1869) and Pearson (1909), for example.

However, early researchers found that tests of quantities like reaction time correlated very badly with achievement criteria like college results. Furthermore, research on transfer of training showed that abilities appear to have a highly specific quality, and it was also noticed that tests of mechanical aptitude correlate poorly with one other. Apparently the intelligence involved in getting college grades differs from that involved in speed of reaction. Furthermore, for example, a good deal of practice in learning English poetry does not facilitate the learning of a French poem--specific skills are needed in each case.

Consequently, up to the 1930's, one view of intelligence was that it is a matter of an enormous number of specifics, one for each kind of task in life. This view may be contrasted with that of Binet, Spearman, and Terman, who regarded intelligence as a single global entity.

Factorial Theories of Intelligence

Spearman (1927) observed that superiority in, say, English usually accompanied superiority in other subjects, although the degree of superiority might differ from subject to subject. Thus, he reasoned that there must be a general factor in intelligence which is used in all situations, although to a differing degree from task to task, plus a number of specifics peculiar to each particular task. The existence of a pure 'g' factor would account for the correlation between skills, but the uncorrelated specifics would account for the portions of the skills which are independent.

Consequently, a similarity of performance on various tasks would be expected to appear, to the extent to which the tests are dependent on 'g', and dissimilarity of performance to the extent that the tests are dependent on uncorrelated specifics. Spearman accounted for the low correlation between motor skills by pointing out that they are dependent to a lesser extent on 'g' and to a greater extent on specifics.

This 'g' plus 's' theory is referred to as the 'two factor' theory of intelligence. Spearman put forward the concept of 'g' as a mathematical quantity which accounts for the correlation between apparently diverse and independent skills, and it is important to think of it as a psychomathematical concept, rather than a substantial quantity.

Whereas Spearman's factorial approach produced only a single, general factor, with little residue, Thurstone (1938) identified a number of primary overlapping factors which he believed best accounted for the positive correlation found amongst mental tests. He obtained eight dimensions of intelligence which he labelled 'Primary Mental Abilities'. The centroid method of analysis yields no general factor, but a series of specifics. The eight P.M.A.'s which Thurstone obtained were identified as:

> V - verbal; P - perceptual; I - inductive reasoning; M - rote memory; D - deductive reasoning; W - word fluency; N - number; S - space.

Guilford (1956) speculated that there may well be no less than 120 identifiable factors involved in intelligence, although only about 50 of them have been isolated to date. He suggests that intelligence should be considered in terms of a three-dimensional model, defined by the dimensions of content, product and process.

Vernon (1950) rejects Thurstone's theories, arguing that they are dangerously close to a return to faculty theory, and he also argues that Spearman's views are inadequate, particularly as it is possible to find aspects of ability which, while clearly being more specific than 'g', are still common to many skills, and therefore, not true specifics.

For example, in attempting to validate Spearman's theory, Brown and Stephenson (1933) applied 20 varied tests to a sample of 300 ten-year-old boys, and obtained correlations between some of the tests beyond what could be attributed to 'g'.

Alexander (1935) too, found that 'g' alone was not sufficient to account for the total variance of a battery of intelligence measures. He

showed that there are other broad factors which, while not present in every measure, are common to a number of abilities which cluster together. He referred to these clustered abilities as 'functional unities', and identified 'v' as a verbal factor and 'f' common to tests of practical ability. He showed that there are factors which operate rather as 'g' does, but with regard to their own functional unities. They lack the generality of 'g', but are more general than 's'.

Brown and Stephenson explained their results in terms of overlap of specifics, a position quite compatible with Vernon's theory. He argues that the correlation not attributable to 'g' results from the presence of group factors of a lower order than 'g', but higher in order than mere specifics. This point of view is supported by Alexander's findings.

Working with Army and Navy recruits, Vernon (1947) identified a further kind of factor, in addition to 'g' and 's'. These further factors arise out of, but are of lesser order than 'g'. Vernon identified them as broad group factors.

In particular, he refers to v:ed and k:m major group factors. V:ed is a verbal-numerical-educational factor, and k:m is a practical-mechanical-spatial-physical factor. More detailed analysis divides these major group factors into minor group factors; thus, v:ed splits into minor verbal and minor numerical factors, while k:m splits into mechanical information, spatial, and manual minor group factors. Continual breaking down would eventually yield specifics in very large numbers.

The model is a hierarchical one, with 'g' accounting for more of the total variance than any other factor, and progressively less being accounted for as movement down the 'genealogical tree' (Vernon, 1950) of

factors occurs.

Intelligence as Cognitive Organization

On the other hand, some theorists have argued that intelligence is best understood in terms of central cognitive processes.

Bruner (1957) explains intelligence in terms of categorization. He noticed that stimuli are often interpreted as similar, although their similarities are less than their differences, and from this he concluded that assignment of input to a category can occur with only minimal clues. Hence, he raises the question of whether level of intelligence can be considered as a function of the ability to assign stimuli to veridical classes with lesser numbers of clues, or else as a matter of possessing a greater armament of class distinctions.

Piaget (1958) thinks of intelligence as involving continually higher levels of organization of intellectual structures, as a result of a continual process of interaction between organism and environment. He perceives distinct stages of intelligence, each stage marked by a logic and consistency of its own but yet imperfect, until eventually the level of true logical intelligence is reached. Thus, for him, intelligence involves increasing generalization and internalization of strategies for coping with the environment, and a progression from the innate schemata of the infant to the formal, abstract, highly symbolic operations of fully-functioning intelligence.

Osgood (1953) too deals with intelligence in terms of organization. He noticed that certain stimuli may take precedence over others, and that the same is true of responses. He argues that this selectivity indicates the presence of organization, as a result of which the structure of the

individual's central nervous system comes to reflect the redundancies of his environment, through predictive and evocative integrations. Hence, intelligence may be seen as the ease with which the integration processes are carried out.

These three theories of intelligence all stress the importance of interaction between organism and environment in the development of intellectual functioning.

II. THE ORIGIN OF INTELLIGENCE

Theories of intelligence suggest that it is a many-sided concept, and the question of where it comes from and how it is nourished arises. Early views held that intelligence is largely an hereditary thing, with environment playing some part in its growth, but studies of intellectual differences from sub-culture to sub-culture have brought the matter of cultural factors into prominence.

Thus, the views on the origin of intelligence fall into two groups--those which favour heredity as the chief source, and those which favour environment. In general, most authorities emphasize that both aspects are important, the relative importance changing according to the particular situation.

Burt suggests (1955) that the contribution of heredity is about 75 per cent, but he points out (1922, p. 1) that environment is also important.

> Poor health, poor homes, irregular attendance. . .these are far commoner as causes of inability. . .than are inherent weaknesses of intellect.

Hebb (1958, p. 126) suggests that there are two aspects of

intelligence which he labels Intelligence A, a kind of unmeasureable potential, and Intelligence B, which arises out of A, is modified by experience, and is measureable. Hebb argues that without the effect of environment, the hereditary portion of intelligence would be useless.

Piaget (1958) too, stresses that functioning intelligence is a function of the interaction between genetic endowment and environment, with the innate aspects undergoing continual re-organization as a result of experience.

Thus, although traditional theorists like Galton, Pearson and Binet put forward the theory that intelligence is an endowed entity which is constant and unchanging over a life-span, the more recent view is that there is an innate endowment, but that it is through the action of environmental factors that this hereditary aspect develops and functions.

Hebb stresses the lasting effects of early experience, and suggests that the role of education is limited, and its effect small compared with the effect of the early environment. Bruner (1961) stresses the importance of the early experience too, referring to Inhelder's suggestion (Bruner, 1961, p. 47) that the first two years of schooling should be given over to activities which will set the pattern of later intellectual functioning.

On the other hand, Davis (1948) takes the view that environmental experiences are specific in their effects, and points out that current environment may well outweigh the past. Consequently, he argues for the possibility of reversing the trends of the past and suggests that a suitable education may have significant effects on intelligence, and overcome past deprivations.

III. SOCIAL STATUS AND INTELLIGENCE

Social Group Differences in Intelligence

It is often argued that intelligence tests produce results for different social groups that do not truly represent their potential. In the 1920's, many research workers reported varying scores among different cultural groups. Thus, Murdoch (1920), Bere (1924), Feingold (1924), Hughes (1928), Goodenough (1926), and Hersch (1926), reported intellectual differences between children from different racial groups. Roberts and Robinson (1932) showed the existence of different ability patterns between Whites and Negroes, and Levinson (1960) has shown that sub-cultural differences exist between Jewish, Italian and Irish children, even though there were no significant IQ differences between groups.

Furthermore, there are many studies which point out that socio-economic status is a key determinant of intelligence. Studies of differences in intellectual ability among minority groups have pointed out that there are characteristic differences in intellectual capacity from socio-economic sub-group to sub-group. One possible view of these differences is that the tests employed are equally valid for all groups, and that differences in sub-culture profiles must result from inferiority, inherited or environmentally induced. However, research has shown that factors such as foreign birth, language background and socio-economic status may result in intelligence differences which are a product of test bias and social class rather than inferior genetic endowment.

Eells (1951) reported that socio-economic status was the chief factor affecting scores on intelligence tests, being greater in its

influence than any of the other cultural factors he investigated. Applying a battery of tests to a sample of nine-, ten-, thirteen- and fourteen-year-olds from various socio-economic backgrounds, he found highly significant differences between the high and low socio-economic status groups on about half the items given.

In general, the differences he found gave the largest advantage to high socio-economic status children on verbal items, and the least on drawing, picture and geometric items.

Similar socio-economic status differences in intelligence have been reported from other countries too. Binet (1916) pointed out that factors depending "partly upon family circumstances" explained the differences betwen his norms and those obtained for a sample of Belgian children. His norming group was selected from French working class families, whereas the Belgian children were from families in easy circumstances.

Stern (1918) reported that upper-class German children had mental ages higher than their lower class countrymen, and Burt (1922) reported similar class differences for English children.

Drawing his sample from two London schools, Burt used one group of children from comparatively good homes rated as "among the best of those sending children to elementary schools" and another consisting of children living in the "meanest of the overcrowded slums that cluster about the railway termini". The results he obtained are shown in Table I, which compares the average mental ages of high and low socio-economic status children at several chronological age levels.

Burt draws attention to the fact that the difference in mean mental

TABLE I

DIFFERENCES IN MENTAL AGE DUE TO SOCIO-ECONOMIC STATUS[a]

Chronological age	Average mental age	
	Superior school	Poor school
7	8.9	6.1
8	10.1	7.2
9	10.6	8.4
10	11.5	9.6
11	12.1	10.3
12	12.8	11.0
13	13.7	11.7
14	14.2	11.6

[a]Burt (1922, p. 191).

age is most marked at the point of transition from the infants' department to the Elementary School. From this, he infers that the depressing effect of socio-economic status is at its peak at about the age of seven, since the difference in mental ages is greatest at this point.

Skeels and Fillmore (1937) found a progressive deterioration in IQ in children in the lowest socio-economic status group, as their age increased, and these results were confirmed by Liechenstein and Brown (1938).

Research involving the enrichment of the environment of children from poor home backgrounds has indicated that nursery schooling improves the IQ of orphanage children, and that children from inferior homes showed similar improvement when placed in superior adoptive homes (Skeels, 1940).

Inkeles (1960) has related the effects of social status to cognitive organization by pointing out that socio-economic status affects perception

and values too.

Attempts have been made to express the relationship between socio-economic status and intelligence in several ways. Thus, Terman and Merrill (1937) reported that children of unskilled labourers average about 20 IQ points below those of professional men, although there is considerable overlap of scores. Similar results were obtained in England by Duff and Thomson (1923). Several studies have attempted to establish a correlation coefficient to express the relationship between intelligence and socio-economic status, and, in general, positive correlations are reported, although they are often low. Thus, in a study of British children, Isserlis (1923) found a positive correlation varying from .30 to .24 between intelligence and socio-economic status, and Havighurst and Breese (1947) reported correlations between .2 and .4 for a sample of American twelve- and thirteen-year-olds. Quinn (1963), working with a sample of 71 Edmonton Grade Five students obtained a correlation of .36 between Laycock IQ and socio-economic status.

The relationship between social class and intelligence has also been expressed in a number of other ways. For example, both Goodenough (1928) and Terman and Merrill (1937) found a systematic reduction in the mean IQ's of social groups arranged in descending order of socio-economic status. Their tests were conducted with pre-school children, and yielded the results shown in Table II.

Goodenough administered the Kuhlmann-Binet to a sample of 380 Minneapolis children, and Terman and Merril gave forms L and M of the revised Stanford-Binet to 831 children.

McGehee and Lewis (1942) showed the relationship between social

TABLE II

MEAN IQ's OF PRESCHOOL CHILDREN CLASSIFIED BY FATHER'S OCCUPATION[a]

Father's occupation	Goodenough	Terman and Merrill
I. Professional	116	116
II. Semi-professional and managerial	112	112
III. Clerical and skilled trades	108	108
IV. Semi-skilled and minor clerical	105	104
V. Slightly skilled	104	95
VI. Unskilled	96	94

[a]Goodenough (1928) and Terman and Merrill (1937).

status and intelligence by obtaining ratios of the occurring frequency of advanced and retarded children against the frequency to be expected from population statistics, and they obtained the results shown in Table III.

TABLE III

RATIO OF EXCEPTIONAL CHILDREN TO NORMAL EXPECTANCY[a]

Social class	Superior	Retarded
Professional	2.40	0.14
Semi-professional and business	1.62	0.49
Skilled workmen	0.88	0.98
Semi-skilled	0.92	1.39
Unskilled	0.30	1.53

[a]McGehee and Lewis (1942).

Their results indicate that high socio-economic status homes produce a high proportion of advanced, and a low proportion of retarded children, while the reverse trend is to be seen for low socio-economic status homes.

Nevertheless, most studies which relate social status to level of intelligence emphasize that there is considerable overlap of scores, and that within-group differences are usually larger than between-group differences.

Some studies have related intelligence to factors in the home life of children, and some substantial correlations have been obtained. Van Alstyne (1929) conducted a comprehensive study of various factors in the home environment of a sample of New York children, and the relationship of these factors to intelligence. The results he obtained are shown in Table IV. It can be seen that parental education was the factor for which he obtained the most significant correlations.

TABLE IV

THE MENTAL AGE OF CHILDREN AS RELATED TO ENVIRONMENTAL FACTORS[a]

Child's M.A. and--	r
Mother's education	.60
Father's education	.51
Opportunity for use of constructive play materials	.50
Number of hours adults spend daily with child	.32
Number of playmates in home	.16
Number of hours father reads to child	.06
'Nutrition Index'	-.03

[a]Van Alstyne (1929).

Thorndike and Woodyard (1942) correlated intelligence with average community income and 'general goodness' of community life for 30 communities, estimating 'general goodness' from expenditure on public health, education and so on, and obtained correlations of .78 for intelligence and income, and .88 between intelligence and 'general goodness'.

Social Status and Language

As early as 1847, Degerando (Chamberlain, 1900) pointed out that the children of the rich and educated use more words and less actions than do the children of the poor, who make greater use of gestures and less of words. Chamberlain (1900) observed that the children of well-to-do families have much larger vocabularies than children of poor families and, in reviewing this research, Markey (1928) refers to the fact that the high socio-economic status children were also superior in the exactness with which they used words.

A study by Young (1947) compared the language behaviour of low socio-economic status children temporarily attending the University of Georgia Nursery School during a local emergency, with the performance of the usual clientele, whose parents paid fees. Using six-hour records of their language, she found that the high socio-economic status children were superior in all analyzed aspects of language. It is interesting to note that these differences appear very early. Irwin (1948) studied phoneme frequency and type of phoneme during the first two-and-a-half years of life, and he found that a relationship exists between language and socio-economic status from the age of one-and-a-half years on.

Studies by McCarthy (1930), Day (1932) and Davis (1937) showed that high socio-economic status children consistently use longer sentences,

more mature sentence forms and show a much greater ability to use functional forms like questions. McCarthy also reported that high socio-economic status children use a lower percentage of nouns until higher age levels, the noun usually being regarded as a less sophisticated usage than other parts of speech.

Some attempts have been made to quantify the differences in language development between the two groups. Thus Smith (1908), carrying out an investigation in three Glasgow schools, found that, whereas the vocabulary of the average five-year-old slum child was only two or three dozen words, the vocabulary of the children from the middle-class homes was at least one thousand words.

Citing Descoeudres, Collins (1939) pointed out that French children from age two to seven showed an advantage of eight months of linguistic development in favour of the high socio-economic status children. Stern (1914) reported an advantage of twelve months for German high socio-economic status youngsters, and Schonell (1942) found that the correlation between cultural level of British homes and English ability was .48.

Burt (1922, p. 190) administered the Binet-Simon Intelligence Scale to a sample of London school children, and compared the performance of high and low socio-economic status children on the various items. He expressed the relationship between item and class by calculating which items were relatively more simple for the high group, and expressed the degree of ease by rating the items from plus six to minus ten. A high plus indicates that the item was relatively easier for high socio-economic status children, and a minus rating indicates that the

low class children found it easier. His findings are partly shown in Table V.

TABLE V

DIFFICULTY OF BINET-SIMON ITEMS FOR CHILDREN OF DIFFERING SOCIAL STATUS[a]

Item	Difficulty
Picture interpretation	+6
60 words	+5
Reading (2 facts)	+5
Dictation	+5
16 syllables	+4
Reading (6 facts)	+4
Differences (abstract)	+4
Sentence building	+4
Mixed sentences	+2
Definition	+2
Differences (concrete	-1
Diamond	-1
Folded paper	-2
2 weights	-2
4 coins	-3
Divided card	-4
Memory drawing	-4
5 weights	-4
9 coins	-5

[a]Burt (1922, p. 194).

Burt also obtained coefficients of colligation between socio-economic status and various items of the Simon-Binet. Some of these are shown in Table VI.

TABLE VI

ASSOCIATION BETWEEN TESTS AND SOCIO-ECONOMIC STATUS[a]

Test	Coefficient of Colligation
Reading (2 facts)	.28
Dictation	.28
60 words	.22
Reading (6 facts)	.24
26 syllables	.18
Sentence building	.20
Picture interpretation	.23
Memory drawing	.11
Pennies and halfpennies	.10
9 coins	.05
5 weights	.03

[a]Burt (1922), p. 197.

The coefficient of colligation is based on a 2 x 2 contingency table comparable to those employed in many χ^2 calculations. It attempts to express the degree of association between two dichotomous categories; in this case, socio-economic status, and accuracy of response to the test items named. Thus, the coefficient of colligation expresses the extent of the tendency for children who are in the upper half of the socio-economic

status category to predominate over children in the lower half of the category in the accuracy of their responses to the items.

Burt's findings led him to conclude that children of superior social status found the following categories of tasks easier:

1. tests requiring linguistic facility
2. scholastic tests, especially tests in literary subjects
3. memory tests requiring memory of sentences
4. tests depending on items of information imparted in a cultured home during early life.

On the other hand, children of low socio-economic status tended to be superior in tasks of the following kind:

1. tests depending upon familiarity with money
2. tests perceptual rather than conceptual in nature
3. more practical tasks
4. tests depending upon critical shrewdness.

Sources of the Language Advantage of High Socio-economic Children

Bühler (1931) has pointed out that children from a neglected milieu are retarded in all aspects of their development--language is one prominent dimension of their general impoverishment. Bernstein (1960) argues that the language lag is not innate, but results from environmental deprivation, with impoverished parents further impoverishing the skills of their children and so on in an endless cycle.

Gatewood and Weiss (1930) placed tiny infants in a darkened room and left them to lie in silence. In this neutral environment which provided no stimulation, the children soon ceased to vocalize and merely lay quiet. From this, it was argued that vocal output in a child is a function of the input he receives from his immediate environment.

Thus, stimulating contact with others is an important factor in the development of verbal skills. Furthermore, a study by Milner (1951)

has shown that such contact is far more characteristic of high than of low socio-economic status homes. Parents of high social status are much better equipped, both by ability and inclination, to provide the kind of verbal stimulation that children need, and are much better able to provide good models for their children. Not only is this the case, but they will, on the whole, tend to reward verbal performance more than lower class parents, in whose world the emphasis is more likely to be on actions.

In fact, De Laguna (1927) argued that high socio-economic status children need language to make headway in their lives, whereas lower class children can not only get by without it, but may despise it as a poor substitute for action. He refers to this as the 'social enterprise' theory of language development, pointing out, in effect, that verbal skills are an essential part of a middle-class child's life from an early stage, whereas the need for verbal skills may not be felt so strongly by the low socio-economic status child.

Drever (1915) has pointed out that travel promotes a spurt in vocabulary building, while other aspects of language develop during more static periods, and Bean (1932) confirms this. Experiences like foreign travel are more characteristic of the life of the child of higher socio-economic status, and so it might be argued that higher class children have both the need and the opportunities to develop superior language skills.

IV. THE DEVELOPMENT OF INTELLECTUAL FUNCTIONING

Stability of IQ

Research already referred to indicates that IQ differences between high and low socio-economic status children are well established at an early age. A number of further studies have shown that there is a high degree of stability in these scores, too.

Shuttleworth (1935) analyzed material in the Harvard Growth Study and reported high correlations between IQ scores at ages eight and eighteen, and Terman (1919) also demonstrated the stability of IQ's over long periods of time.

Terman conducted a series of re-tests with a total of 435 children aged between three and fifteen at the first testing. The second tests were administered at intervals of from one day to seven years after the first. In 26 cases, the IQ was the same at both testings and, in general, stability of IQ scores was demonstrated. The mean change was only 1.7 points, and the middle 50 per cent of the changes lay between an increase of 3.3 points and a decrease of 5.7 points. From this, Terman concluded that IQ scores display a good deal of stability over even so long a time as seven years.

This result was confirmed by the findings of Brown (1950). He tested 51 first-graders with the Stanford-Binet, and subsequently re-tested them twelve years later, using either the Army Alpha Test or the Otis Higher Test. He, too, reported great constancy of scores. The largest variation among the 51 subjects was nine points, and the mean change was 3.88. Nearly half the sample varied by three points or less.

Thorndike (1940) reviewed test re-test studies, and concluded that correlations vary from about .89 when re-testing is immediate to .70 after five years.

Although these findings all indicate a substantial degree of IQ stability, Ebert and Simmons (1943) obtained diminishing test re-test correlations over a three-year interval, as the age of the subjects at first testing was reduced. Honzik, MacFarlane and Allen (1948) supplemented the original findings by extending the age-groups concerned. Findings in the two studies are shown in Table VII.

TABLE VII

CORRELATIONS OBTAINED BETWEEN IQs THREE YEARS APART[a]

Age at first testing	9	7	5	4	3	2
Correlations of IQs	.85	.76	.70	.55	.56	.32

[a]Ebert and Simmons (1943) and Honzik, MacFarlane and Allen (1948).

These results show that individual IQ's obtained from age five years on are quite stable, but that there is a sharp drop in the reliability of IQ scores obtained with younger children.

Bayley (1940) compared scores on the California Pre-school Schedules at 7, 8 and 9 months of age with IQ's at six years of age, and obtained a correlation of the order of zero between the scores. Later, Bayley (1949) reported the results of repeated observations of from 40 to 50 individuals from birth to age eighteen years. The correlations between IQ at eighteen years and scores for earlier testings are fairly

stable at about .70 from the age of seven years on, but are much lower for the first testings conducted at earlier ages, and fall to the order of zero.

The Honzik, MacFarlane and Allen, and the Bayley results are shown in Figure 1.

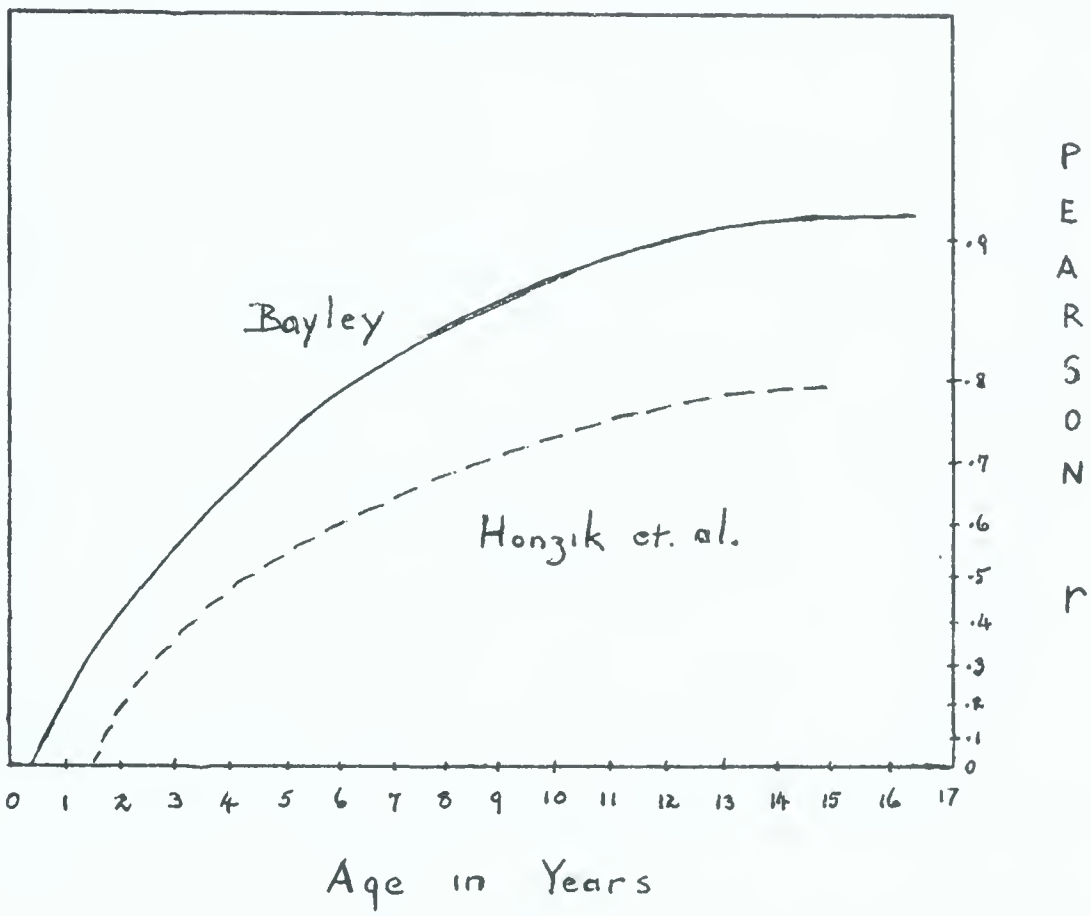

FIGURE 1

CORRELATIONS OF INTELLIGENCE SCORES AT 18 YEARS OF AGE WITH SCORES AT SUCCESSIVE EARLIER AGES[a]

[a]Bayley (1949) and Honzik, MacFarlane and Allen (1948).

Again, these results indicate that, with the exception of very early IQ's, scores tend to be stable.

It seems, then, that the numerical value of the IQ is established at about the fifth year, and this point of view is supported by

several theorists. Bruner (1961) stresses the importance of intellectual patterns established in the first years of school, and he refers to Inhelder's contention that the first two years of school should be given over to the establishment of modes of intellectual functioning which will tend to persist in later life.

Harvey, Hunt and Schroder (1961), too, stress that early training has lasting effects on the conceptual framework of the individual, and the characteristic modes of functioning which he adopts. Hunt (1961), referring to the work of Piaget, again emphasizes the importance of early experience in the development of intellect.

These studies support the supposition that there will be a high degree of stability in the IQ's obtained by the sample employed in this thesis, but it is conceivable that there may be qualitative changes in the intellects of its members with the passage of two years.

Differentiation of Abilities

A study particularly relevant to this thesis was that of Estes (1953). Working with a group of seven-year-olds, and another of ten-year-olds, she divided them into high and low socio-economic status groups and compared the full-scale Wechsler Intelligence Scale for Children (WISC), IQ's of the groups. She found mean differences between the high and low groups which were significant at the one per cent level in the case of the seven-year-olds, but not significant in the case of the ten-year-olds.

Three years later (Estes, 1955) she re-tested the seven-year-old group, now ten years old, and she found that the differences were no

longer significant. From this she concluded that the effect of socio-economic status decreases with age. However, her sample, originally small, was further reduced by the loss of subjects at the second testing. She may well have re-tested only those members of the low status group who had adopted middle-class habits, including residential stability, and whose test patterns would be more typical of the middle-class than of the more mobile lower class.

Opinion and research on the development of intelligence suggests that there is a progression from the use of a general, undifferentiated, intelligence to an intellectual functioning which rests largely upon the application of more differentiated, specific abilities. This process of development of specific abilities out of a basic matrix is referred to as differentiation of abilities.

Burt (1954) in reviewing his research on the subject over the preceeding thirty-five years, concludes that the influence of the general factor is at its greatest in early years and diminishes with advancing maturity. However, he argues that many tests of intelligence which are so constructed as to measure few specifics, are unlikely to show this diminishing dependence on the general factor. Burt conducted two studies to test the relative importance of the 'g' factor, and in each case found that the portion of the total variance which it contributed decreased with increasing age of the subjects.

The first study he reported (1954) showed that the general factor accounted for 52.1 per cent of the total variance at age eight and only 27.8 per cent at age twelve. In a later study (1954) in which the items in the test were much less school-achievement oriented, and included

measures of memory, imagination, verbal facility, manual dexterity and so on, he also found a decline in the portion of the total variance accounted for by the general factor from age ten to fourteen.

Garrett (1946) also reasoned that, with increasing age, intellectual functioning seems to depend to a lesser extent on an 'amorphous' general ability and more on specific aptitudes. He differed from Burt in that he saw the effect of age as being a matter of widening experience and divergence of interests rather than merely maturation. Garrett, too, obtained a decreasing variance contribution on the part of the general factor.

Other researchers such as Asch (1936) and Clark (1944) obtained results which support the notion of decrease in first factor contribution to intellectual functioning as age increases, and consequent importance of specific aptitudes. Balinsky (1941) showed this decline in a study conducted with the Wechsler-Bellevue tests, although, after age thirty, the general factor variance began to increase again.

Working with a sample of English school children,Dockrell (1962) applied a battery of six tests, chosen to yield a clearly defined general factor and to measure specifics too. The tests sampled language skills, numerical skills and measures of practical and manual ability.

He found socio-economic status differences significant at the one per cent level, for ten-, twelve- and fourteen-year-olds. He also found a continuous decline in the importance of the general factor in the case of the low socio-economic status group, but no comparable decline for the high group. Furthermore, he found a significant second factor already present in the case of the middle-class children at the age of ten, whereas

this factor did not appear until the age of twelve in the case of the low social status group. Thus, the pattern of intelligence common to all the children by the age of twelve, was already present in the high social status group at ten.

However, the evidence on the question of differentiation of abilities is far from conclusive--Blumenfeld (1946), Swineford (1947) and Doppelt (1950) all reported results which failed to agree with the work previously referred to. McNemar (1942) carried out factor analyses of Terman-Merrill scale items at mental age levels ranging from two to eighteen years and obtained irregular results, which were too inconsistent to establish the presence of any systematic trend.

Using the WISC and the Wechsler Adult scale, Cohen (1956) found that children rely less on the general factor than do adults. Thus, his results indicated increasing dependence on the general factor with increasing age. His results are shown in Table VIII.

TABLE VIII

PROPORTION OF TOTAL VARIANCE ATTRIBUTABLE TO 'G' AT VARIOUS AGE LEVELS[a]

Age group	Proportion of variance due to 'g'
Children (using WISC)	
$7\frac{1}{2}$	30
$10\frac{1}{2}$	40
$13\frac{1}{2}$	36
Mean	35
Adults (using WAIS)	
18 - 19	53
25 - 34	50
45 - 54	54
Mean	52

[a]Cohen (1956).

Peel and Graham (1952) re-tested a group of 10½-year-olds who had previously taken a battery of tests at nine, and they reported an increase in general factor variance. However, Vernon (1950, p. 140) has pointed out that this is to be expected when the tests become easier and less demanding, as was the case with Peel and Graham's sample, who had the advantages of both increased experience, and previous practice at the second testing. Thus, the difficulty level of the test will be one factor affecting the direction of changes in the magnitude of the general factor, as the ages of subjects vary.

The lack of agreement concerning the effect of increasing age on 'g' variance may spring from a number of other sources, too. For example, sampling techniques which produce increasingly homogeneous samples will tend to produce results which show a decrease in the importance of the general factor, as all the members of the sample tend to apply common skills to problem-solving.

Furthermore, Burt (1922) has suggested that the difficulty of studying differentiation of abilities is increased by the use of different tests in the various studies. If the tests used are heavily dependent on 'g', a decrease in general factor variance cannot be expected.

Burt also argued that, if the tests are chiefly measures of school achievement, or are heavily school-oriented, a tendency towards school-imposed homogeneity of intellectual functioning will make itself apparent in increased general factor variance.

This point has been demonstrated by Williams (1948, in Vernon, 1950, p. 30). He applied a battery of ten intelligence, spatial and mechanical tests to samples of twelve-, thirteen- and fourteen-year-old

boys, and obtained a steady increase in general factor contribution to variance. He interpreted this as indicating that the secondary education common to all the boys, tended to greater integration of abilities rather than differentiation.

Vernon (1950) confirmed Williams's findings by applying a battery of tests to fourteen-year-old school leavers, and comparing their results with those of seamen recruits in the British Navy, who had left school at fourteen, four years previously. He found that 'g' saturations were almost identical, suggesting that age does not in itself involve changes in general factor variance, and that level of education is a determinant of the degree of differentiation of abilities, especially in tests of school-type skills.

Vernon (1950, p. 30) concludes that there is no general tendency towards differentiation, except perhaps in early infancy. He argues that the key factors are educational and vocational training. Consequently, differences between results obtained in Britain and the U.S.A. may reflect differing educational practices in the two countries.

V. CONCLUSIONS

Consideration of the relevant literature leads to the following conclusions:

1. Intelligence has no unique definition. In fact, several theorists have advanced plausible explanations of intelligence, with empirical evidence to support their differing conceptions.

2. Children from different socio-economic levels show large differences in their scores on intelligence tests.

3. The aspect of behaviour in which high socio-economic status children have the greatest advantage is that of verbal skills.

4. IQ patterns are established at an early age and tend to persist throughout life. However, there are changes in the nature of intellectual functioning as individuals mature, and these changes may be associated with the development of specific skills.

On the basis of these conclusions, specific hypotheses were set up concerning the probable outcome of the experimental procedures adopted in this study.

CHAPTER III

DEFINITIONS, POSTULATES AND HYPOTHESES

I. DEFINITIONS

Intelligence. Intellectual ability or mental power, which is the product of genetic endowment and experience. It is not directly measurable, but is inferred from test results. For the purposes of this study, it will be thought of in terms of Vernon's hierarchical model.

General intelligence. The psychomathematical concept which accounts for the correlation between apparently diverse and widely different skills. Operationally, it manifests itself in the application of a general, undifferentiated ability to the solving of differing problems. It results from the use of a single skill in many situations, or from the basic uniformity of seemingly very different intellectual tasks. (Adcock, et al., 1954).

Group factors in intelligence. Subsidiary abilities, over and above 'g' are called group factors. They run through a limited group of tests, which cluster together by virtue of some group ability, common to them but not found in other groups of tests.

Specific intelligence. Particular skills peculiar to single tests, and remaining after the portions of the tests dependent on general and group intelligence factors have been removed. Thus, any one test may be expected to measure general ability, group intelligence and specific

intelligence, although the degree to which it measures each may vary markedly.

Socio-economic status. The social position held by an individual by virtue of considerations such as income, education, breeding and place of residence. It is assumed that members of any one socio-economic status group will enjoy similar home conditions and opportunities, and will share common values, attitudes and aspirations.

II. POSTULATES

1. The effect of socio-economic status on intelligence is such that there will be differences in intellectual functioning between socio-economic status groups. These differences will be detectable by intelligence tests unless they have been so constructed as to eliminate its effect.

2. As individuals mature, the effects of training and maturation will result in changes in the pattern of their intellectual functioning, and these changes will be detectable in the factorial patterns of test scores at differing age levels.

III. HYPOTHESES

On the basis of the relevant literature, the following specific hypotheses were established.

A. The effect of socio-economic status on WISC sub-test scores.

1. The mean sub-test scores obtained by the high social status portion of the sample will be significantly different from the mean sub-test scores obtained by the low group,

in the case of verbally loaded sub-tests.

2. There will be no significant differences between the sub-test means in the case of performance sub-tests.

B. The correlation between intellectual skills and socio-economic status.

3. There will be correlations significantly different from zero between sub-test scores and socio-economic status.

C. The factor analyses of the correla tion matrices.

4. The proportion of the total test variance accounted for by the general factor will differ at the two testings.

5. A factor defined by three measures of socio-economic status will be obtained, and verbal sub-tests will tend to load more heavily on this factor than will performance sub-tests.

6. Inter-battery factor analysis will indicate the presence of factors common to both administrations of the scale.

CHAPTER IV

EXPERIMENTAL DESIGN

I. THE SAMPLE

In 1960, a sample of Edmonton school children was selected on the following basis. Every third child born in the months of June, July, and August 1950, and currently receiving instruction in an Edmonton Public School Board classroom was chosen. In this way, it was argued, the sample could be said to be random. The children were spread over Elementary Schools in all parts of Edmonton, thus representing no particular area of the city, and they ranged in grade placement from grades four to six, with one girl in grade two.

This selection procedure yielded a sample of 101 children, and each of these was tested with the Wechsler Intelligence Scale for Children. IQ's ranged from 73 to 142, and the mean full-scale IQ for the entire group was 115.3. This high mean was presumably accounted for by such factors as the absence of institutionalized children, the absence of any children in Edmonton whose cultural disadvantage is extreme, and the absence of rural children from the sample.

Two years later, 70 of the original children were again contacted in the Junior High Schools to which most of them had transferred. The grade range was now from grades six to eight, and the mean IQ for the sub-sample of 70 was 117.0. This score does not differ significantly from the mean for the full random sample, and thus the sub-sample does not differ from the original sample as far as IQ is concerned.

Consequently, the sample eventually employed consisted of 70 Edmonton school children, aged twelve in April and May 1963 when they were re-tested.

II. THE INSTRUMENTS

The Wechsler Intelligence Scale for Children

The Wechsler Intelligence Scale for Children (the WISC) is an instrument particularly suited to this study. Its structure conforms well to a theory of intelligence like that of Vernon--the sub-tests may be regarded as measures of specifics, with an underlying, unifying dependence on 'g', and the three IQ scores appear to be good measures of more general factors. Thus, the verbal IQ may be regarded as an estimate of v:ed, the performance IQ of k:m, and the full-scale IQ as an estimate of 'g'.

Hence the scale permits analysis of results in terms of a hierarchical model of intelligence, and the making of comparisons between social groups along several dimensions of intellectual functioning.

Cultural bias in the WISC. There are many studies which point out that socio-economic status is a key determinant of intelligence. Various studies have shown that socio-economic status may result in intelligence differences which are a product of social class and test bias rather than inferior genetic endowment.

Certainly, the WISC has social class biases. Many of the items are relevant not merely to the North American culture only, but to certain segments of that culture. Young and Bright (1954) applied the WISC to a

group of Southern, negro, rural children, and the subjects' responses led to the conclusion that the test norms are open to question when used with a group whose background differs so markedly from that of the standardizing sample. This point of view has been supported by the studies of Estes already cited. (pp. 30, 31).

Consequently, the question arises as to which sub-tests on the scale are most heavily socio-economic status loaded.

Factorial content of the WISC sub-tests. Several investigations have been made of the sub-test content of the WISC, through the use of factor analytic techniques. In general, they have shown the existence of a strong general factor and a number of more specific factors; the nature and number of specifics varies according to the particular analytic technique employed.

Maxwell (1959) set the first factor through vocabulary and rotated to keep the second factor orthogonal to the first. After the extraction of the second factor the residual variance was insufficient to permit the extraction of further factors. Maxwell's analysis was conducted at three age levels--$7\frac{1}{2}$ years, $10\frac{1}{2}$ years and $13\frac{1}{2}$ years, and the loadings he obtained are shown in Table IX. In general, there is a high degree of stability in the factors and factor loadings he obtained.

Although Factor I was set through vocabulary, and is thus defined as a verbal factor, it also loads highly on Object Assembly, Coding and Block Design, so that it is not solely verbal in nature. Maxwell suggested that it is a mixture of a general and a verbal factor, and he labelled it 'vg'.

TABLE IX

ROTATED WISC FACTOR LOADINGS[a]

Test	Factors Age 7½ years I	Age 7½ years II	Age 10½ years I	Age 10½ years II	Age 13½ years I	Age 13½ years II
Comprehension	59[b]	10	76	-06	71	-16
Arithmetic	62	09	74	-06	62	-03
Similarities	61	07	73	-24	76	02
Vocabulary	76	00	88	-03	78	00
Digit span	58	08	54	-02	46	-01
Pic. completion	48	12	52	25	39	54
Pic. arrangement	56	34	64	12	49	32
Block design	42	53	66	47	53	54
Object assembly	37	69	49	49	37	74
Coding	33	24	45	00	66	19
Verbal IQ	85	11	93	-14	91	-06
Performance IQ	64	51	78	31	61	55

[a]Maxwell, 1959.

[b]All decimal points have been omitted.

Factor II shows high loadings, at all age levels, on Block Design and especially Object Assembly. This suggests that these two sub-tests measure something different from the rest of the performance sub-tests--Maxwell referred to Factor II as a space performance factor and labelled it 'sp'. The particular value of this analysis, according to Maxwell, is that the factors obtained are relatively stable.

Cohen (1959) carried out a factor analysis of the scores obtained by the original standardization sample as reported in the test manual. He used the Thurstone centroid method of analysis, and performed an oblique rotation to obtain five primary oblique factors. In interpreting the factors he regarded a loading of .20 as significant. The five factors he obtained, with the names he gave them are shown in Table X.

TABLE X

OBLIQUE PRIMARY FACTORS FOR THREE AGE GROUPS[a]

Sub-test	Age	A Verbal Comp. 7-6	10-6	13-6	B Percpt. Org'n 7-6	10-6	13-6	C Free Distr. 7-6	10-6	13-6	D Verbal Comp.II 7-6	10-6	13-6	E (Quasi-specific) 7-6	10-6	13-6
Information		41[b]	32	39	-02	02	07	-09	-02	10	02	15	00	17	00	-10
Comprehension		-10	-06	37	-02	-01	-10	-09	06	-07	47	38	20	09	-05	07
Arithmetic		21	41	07	-04	04	-04	17	10	36	-06	-09	02	18	08	-05
Similarities		34	38	26	09	-05	02	09	02	00	-01	08	24	-10	-06	09
Vocabulary		21	05	47	-07	07	00	-04	07	-10	26	30	-01	05	00	08
D. Span		-04	04	02	-04	00	01	38	44	33	02	-09	00	04	-04	-10
P.C.		-06	04	-05	06	43	50	09	-10	04	28	21	27	-10	-04	-10
P.A.		01	-02	-02	29	07	09	33	-09	-06	-01	09	14	-10	38	33
B.D.		06	02	07	50	55	46	-08	15	01	07	03	10	09	04	-03
O.A.		-01	-05	-03	50	49	57	07	32	-09	-05	-05	-08	09	-04	10
Coding		-07	03	01	06	-05	-01	06	09	10	-01	-03	-10	39	23	25
Mazes		05	-02	-05	56	42	03	-04	20	23	-02	02	-03	04	01	10

[a]Cohen (1959).

[b]All decimal points have been omitted.

Since oblique factors are correlated, it was possible to carry out a further analysis of the matrix of intercorrelations between factors. Using this technique, Cohen obtained a substantial secondary factor, which accounted for almost all the intercorrelation between factors, and for about a third of the total variance.

Gault (1954) carried out factor analyses of WISC scores for two age levels--10½ and 13½ years. The factors he obtained indicate the presence of a substantial general factor accounting for about a third of the total variance, and show the continuity and equivalence of the factorial structure of the test at the two age levels. Using Burt's modified orthogonal bifactor procedure, he obtained the factor loadings shown in Table XI.

TABLE XI

A COMPARISON OF THE FACTORIAL PATTERN OF THE WECHSLER INTELLIGENCE SCALE AT TWO AGE LEVELS[a]

	Age 10½				Age 13½			
Sub-test	I	II	III	IV	I	II	III	IV
Information	69[b]	-07	48	21	69	-03	51	10
Comprehension	65	-01	44	15	54	-09	48	01
Arithmetic	57	04	31	42	53	-11	36	30
Similarities	58	-09	43	22	66	05	48	03
Vocabulary	75	08	42	18	66	01	51	01
Pic. Completion	57	31	15	-17	49	49	09	-01
Pic. Arrange.	51	12	22	34	51	33	00	38
Block Design	61	49	00	22	60	56	11	-02
Object Assembly	49	51	-02	16	49	55	00	06
Coding	33	05	16	38	43	13	14	24
% total variance	32	7	8	8	30	9	10	6

[a]Gault (1954).

[b]All decimal points have been omitted.

Gault's Factor II approximates Maxwell's 'sp' factor, and Factor I seems to be very similar to his 'vg' factor. Furthermore, both these pairs of factors bear a close resemblance to the perceptual organization and verbal comprehension factors identified by Cohen. In fact, a comparison of the three analyses indicates that there is a substantial degree of agreement concerning the factorial content of the sub-tests.

The Measures of Socio-Economic Status

Agreement is lacking as to just what constitutes the most acceptable measure of socio-economic status, and so many scales are to be found in use. Early investigators assumed that three categories could be used--better class, average and poor class. (McClaren, 1950). Terman (1916), carrying out the 1916 revision of the Stanford-Binet scale, used five social groupings--very superior, superior, average, inferior, and very inferior. Later scales used a continuous grading system, and the occupation of the father was often used as the criterion of a child's social status.

Socio-economic status by occupation. Thus, Taussig (1928) divided social class into five categories on the basis of occupation:

1. day labourers
2. unskilled workmen
3. lower middle-class
4. clerical and semi-intelligent occupations
5. well-to-do professional men, business men and managers of industry.

The use of occupation as the criterion of socio-economic status is supported by the research of Kahl and Davis (1956), who showed that, although all measures of social status correlate highly, occupational status is the one measure most heavily saturated with the general social status factor.

This point of view is supported by Caplow (1954) who pointed out that there are widely held assumptions regarding the social superiority and inferiority of various occupations.

1. White collar work is superior to manual work.
2. Self employment is superior to working for pay.
3. Clean occupations are superior to dirty ones.

Hollingshead (1958) also takes occupation into account in determining socio-economic status in his studies of social class relationships in the U.S.A.

That socio-economic status is largely determined by occupation is recognized outside psychology too. Steinbeck (1961), referring to this social fact, makes one of his characters who is speaking to the last of the noble Hawleys, educated and well-bred, say:

> 'In this town or any other town, a Hawley grocery clerk is still a grocery clerk.'

Not all the Hawley birth or breeding could raise the grocery clerk above the status conferred by his occupational level.

Another scale was prepared by Edwards, who divided occupations into the following six categories, in descending order of superiority:

1. professional
2. proprietary and managerial
3. clerical and sales
4. skilled and supervisory
5. semi-skilled
6. unskilled.

This scale, which reflects the occupational stratification of the Edmonton community, suggests itself as a useful instrument in determining social status, for the purposes of this study.

Sociopsychological aspects of social class. However, the concept

of social class should not be thought of as a single entity, since it has at least two major aspects. (Page in Bendix and Lipset (eds.), 1953, p. 48). The first of these is rooted in the economic cleavages of a community, and rests upon economic-occupational considerations. It is this aspect of class which occupational scales seek to measure.

Nevertheless, there is a second important aspect of social class. This is the socio-psychological aspect, which emphasizes the role of class attitudes and values in social stratification. Although socio-psychological cleavages arise out of and reflect the economic strata within a community, Page points out that the relationship between socio-economic and socio-psychological aspects of class is by no means isomorphic; the attitudinal structure of society does not exactly parallel the economic structure upon which it is based.

Consequently, although each aspect is a legitimate dimension of social class, neither is a complete measure of socio-economic status when used exclusively, and a more comprehensive measure must take account of both aspects of social class. Hollingshead has suggested that three factors should be taken into account--

1. Where a family lives.
2. The way it makes its living.
3. Its tastes and cultural orientation.

He concluded that occupation is a satisfactory measure of the second of these, and the education of the head of the family of the third. Residential status depends on the residential patterns of the community in which the subjects live.

Validation of the Hollingshead scale was undertaken in New Haven, using as criterion the rated social status of the sample. Rating was done

by a panel of judges familiar with the social structure of New Haven. A correlation of .906 was obtained between rated status and the best combination of predictors 2 and 3. This is a satisfactorily high coefficient of validity, and omission of measure 1 in this study avoids difficulties in rating areas of Edmonton according to prestige, a task complicated by the essentially fluid nature of the local society, and the comparative recency of the city's development.

Applying the Hollingshead Index to a sample of University of Alberta, Calgary, freshmen, Rootman (1963) found that he was able to make a socio-economic division of them which appeared to be valid in terms of their general standing in the community. From this, he concluded that the scale is a measure of socio-economic status useful for the local society, although he found it necessary to omit the residential measure in view of the difficulty of assessing the residential status of the city of Calgary.

In judging occupational status, Hollingshead used a modified version of the Edwards scale. His objection to the Edwards scale was that it does not differentiate among kinds of professions, nor does it take into account the size and economic strength of businesses. Hollingshead sought to rank the professions, and to distinguish among businesses according to their size and value.

Consequently, the Hollingshead scale uses the following seven-point rating of occupations.

1. Executives and proprietors of large concerns, and major professionals.
2. Managers and proprietors of medium-sized businesses and lesser professionals.
3. Administrative personnel of large concerns, owners of small independent businesses, and semi-professionals.

4. Owners of little businesses, clerical and sales workers and technicians.
5. Skilled workers.
6. Semi-skilled workers
7. Unskilled workers.

The progression in this rating system is from unskilled physical labour, through the use of skill, to creative talents, ideas and the management of men.

The use of education as a measure of socio-economic status was based on the assumption that general cultural level is determined by education, and that a similar level of education in a group will result in common interests, tastes and attitudes within the group. The education scale was based on a seven-point rating scale.

1. Graduate professional training.
2. Standard college training.
3. Partial college training.
4. High school graduation
5. Partial High School.
6. Junior High level.
7. Less than seven years of school.

A Hollingshead socio-economic status score was obtained for the present sample from the best weighting of occupation and education, basing the weightings on the correlations obtained for the New Haven sample.

The Home-Index. In an attempt to get at the life-style of the subjects, a socio-economic status measure was sought which would yield a score for each child based on the 'general goodness' of his home life.

Basing it on a reworking of earlier scales, Gough (1949) developed a 'Home-Index' scale which is well suited to the present study. The scale consists of a 20 item questionnaire requiring answers of "yes" or "no" only. According to the Flesch (1948) readability standards, it is

within the ability of this group, and it correlates well with other measures.

Elley (1961) found that some portions of the Gough Index were unsuitable for Alberta, and he employed a modified version of the scale with which he obtained good socio-economic separation of a sample of Alberta school children. Consequently, Elley's modified version of the Gough Index was employed, in order to obtain a further estimate of the social status of the sample.

It was not necessarily intended that the use of three measures of socio-economic status would isolate all the relevant social variables; what was sought was an assessment of the socio-economic status of the sample from several different points of view. Thus, to summarize this section, socio-economic status scores were obtained for each child involved in the study, on the basis of parental occupation, parental education and home circumstances.

III. EXPERIMENTAL PROCEDURE

The Wechsler Intelligence Scale for Children was administered to the sample on two occasions two years apart; the first administration was carried out in 1961 and the second in 1963.

In addition to the WISC, information about the children's parents and home circumstances was obtained in 1963, and from this three socio-economic status scores were derived--one based on the Edwards Occupation Scale, one on the Hollingshead socio-economic status scale, and the third from the scoring of the Gough Index.

On the basis of the socio-economic status scores, the children

comprising the sample were divided into two groups--a high socio-economic status group and a low status group. The criterion for placement in the high group was a total social status score of less than 25, and this procedure yielded a high group containing 36 members, and a low group containing 34 members. The cutoff point of 25 was chosen as it represents the approximate mean of the full range of possible scores on the three measures.

After selection of the high and low status groups, the respective means obtained by each group on each of the ten sub-tests of the test were calculated, and the differences between means of the high and low groups were tested for significance. This procedure was adopted with both the 1961 and the 1963 protocols.

Furthermore, the matrix of correlations between the pooled sub-test scores of the entire sample was calculated, and subjected to further analysis.

IV. STATISTICAL ANALYSIS

Tests of Significance

Mean differences. A. The significance of differences between means was tested by the use of two-tailed t-tests for the significance of differences of uncorrelated means, using the formula

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

The .05 level was taken as indicating statistical significance, for the purposes of this study.

Correlation coefficients. B. To test the significance of a correlation coefficient, Ferguson (1959, p. 153) suggests the formula

$$t = \sqrt{\frac{N - 2}{1 - r^2}}$$

and this was adopted. The number of degrees of freedom associated with this expression is N - 2, since the correlation coefficient is the slope of a regression line, in standard-score form, and the number of degrees of freedom associated with fitting a straight line to any number of points is always equal to two less than the number of points involved.

Substituting into this formula, the critical value of r for significant difference from zero is .24 at the .05 level of confidence, and .29 at the .01 level of confidence, with 68 degrees of freedom.

Factor Analysis

Factor analysis is a technique which enables consideration of several tests in terms of a lesser number of dimensions. If a number of tests are administered to a group of individuals, and there is a high degree of correlation between the resulting scores, it may be assumed that the tests are measuring something in common, and that the magnitude of this common quantity is a function of the amount of common variance shared by the tests. This common variable is expressed mathematically as a factor. Thus, a factor is a hypothetical variable common to several tests, and the factor loadings express the correlations between the tests and the variable represented by this factor.

Principal-axis factor analysis. The particular method of factor analysis adopted for the purposes of this study was the principal-axis method. This technique maximizes the contribution of the factors to the

total variance, and is especially suited to the requirements of this study. In particular, it yields the largest general factor which is mathematically possible from the correlations obtained, thus enabling comparisons of general factor contribution to be most strikingly made.

Consequently, the matrices of correlations between sub-tests obtained at both the 1961 and 1963 testings were subjected to principal-axis factor analysis, using unities in the diagonal cells of the matrices. The computations involved were carried out on the University of Alberta's IBM 1620 computer, using the Jacobi method of analysis.

The varimax factor rotation. In order to facilitate the interpretation of the factors thus obtained, analytical rotations were then carried out, using Kaiser's (1960) normal varimax technique. The criterion for selection of significant factors was that suggested by Kaiser--the factors which had an eigenvalue of one or greater were regarded as significant since they contributed more to the total variance than a single test. Consequently, varimax rotations were performed with the factors which contributed more than unity to the total variance.

The inter-battery factor analysis. A further factor analysis was carried out using the intercorrelations between the 1961 and 1963 sub-test scores. This technique is referred to as inter-battery factor analysis, and yields factor loadings on only the factors which are common to both batteries of sub-tests. The computations involved were carried out according to the procedure suggested by Tucker (1956).

If R_{12} is the matrix of inter-battery correlations the first step involves obtaining the matrix H_1 where

$$H_1 = R_{12}R'_{12}$$

This matrix is then subjected to the normal eigenvalue eigenvector analysis to yield matrix W_1 and characteristic roots γ^2. From this, the matrix A_1, representing the loadings of the sub-tests of the first battery on the factors common to both batteries, is obtained, such that

$$A_1 = W_1\gamma^{\frac{1}{2}}$$

The sub-test loadings of the second battery on the common factors are obtained from the formula,

$$A_2 = W_2\gamma^{\frac{1}{2}}$$

where

$$W_2 = W_1R'_{12}\gamma^{-1}$$

This procedure yields loadings on only those factors which are common to both batteries, thus permitting direct comparison of the factorial structure of the two batteries.

CHAPTER V

RESULTS OF THE STUDY

The results obtained in this study were arranged and reported in tabular form. They may be considered as falling into four categories;

1. Findings arising from the sub-test means and mean differences.
2. Findings resulting from the sub-test intercorrelation matrices.
3. Findings arising out of the factor analyses of the two sub-test batteries.
4. Findings connected with the inter-battery factor analysis.

Sub-Test Mean Differences

Table XII shows the sub-test means for the two socio-economic status groups at age 10, the mean differences between group scores, and the significance of these differences.

It can be seen that, at this age level, there were differences significant at the .05 level or beyond, in the case of **I**nformation, **A**rithmetic, **S**imilarities and **V**ocabulary, while there was also a significant mean difference in the case of **O**bject **A**ssembly. The mean performance IQ's were not significantly different, but both verbal and full-scale IQ's were significantly different beyond the .01 level of confidence.

Thus, it can be seen that differences between the two groups tend to lie in the verbal area.

Table XIII compares sub-test means obtained at age twelve. At this age-level, there were statistically significant differences between high and low group means in the case of Information, Comprehension,

TABLE XII

MEAN DIFFERENCES BETWEEN HIGH AND LOW SOCIO-ECONOMIC STATUS GROUPS AT AGE TEN

Group	Sub-test	Inf.	Comp.	Arith.	Sim.	Vocab.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ
High	Mean	13.3	14.2	12.5	13.7	13.1	13.2	12.3	11.6	11.7	13.1	121.3	117.3	121.2
	S.D.	2.76	3.28	2.18	2.95	1.47	3.20	3.24	3.53	2.55	3.01	10.8	11.9	10.6
Low	Mean	11.65	12.6	11.2	12.4	11.7	12.6	12.0	11.4	10.1	12.8	111.9	112.3	113.4
	S.D.	2.70	4.00	3.02	2.80	2.18	3.53	3.38	2.72	2.93	3.30	13.0	13.1	12.0
	Mean Diff.	1.65	1.59	1.29	1.37	1.35	.636	.307	.453	1.61	.286	9.46	4.98	7.8
	t	2.52	1.92	2.04	2.08	3.09	.767	.454	.604	2.44	.379	3.29	1.66	2.65
	p	.05	n.s.	.05	.05	.01	n.s.	n.s.	n.s.	.05	n.s.	.01	n.s.	.01

Arithmetic, Similarities and Vocabulary. However, there were no significant differences in the case of the five performance sub-tests. Again, the mean differences for verbal and full-scale IQ's were highly significant, although the difference between performance IQ means was not significant. At this level, the mean difference in the case of performance IQ's was very close to significance at the .05 level.

A comparison between Table XII and Table XIII shows that, at the twelve-year age level, the mean differences between all verbally loaded sub-tests are significant, while the corresponding differences between performance means are not significant in any case. Thus, the pattern of high socio-economic superiority markedly evident at ten years of age is now clearly associated with verbal measures.

Furthermore, it can be seen that there is an overall tendency for t's to increase at the second testing, and that performance sub-test differences are generally nearer to significance than they were at age ten.

In general, these results support hypotheses 1 and 2. At age ten, and again at age twelve, the high socio-economic status group has scored significantly better on sub-tests of the scale which have been demonstrated in other studies to be saturated with verbal skills.

Sub-Test Intercorrelations

Pearson product-moment correlation coefficients between the various sub-tests and socio-economic status are shown in Table XIV, for both age levels.

At age ten, it can be seen that about half the correlations (13 out

TABLE XIII

MEAN DIFFERENCES BETWEEN HIGH AND LOW SOCIO-ECONOMIC STATUS GROUPS AT AGE TWELVE

Group	Sub-test	Inf.	Comp.	Arith.	Sim.	Vocab.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ
High	Mean	13.0	14.4	13.7	14.6	13.0	13.2	13.3	12.1	11.7	14.2	123.8	120.6	124.4
	S.D.	2.53	2.00	3.13	2.88	2.05	3.37	3.01	3.29	2.88	2.91	11.9	12.2	11.9
	Mean	11.0	12.3	11.9	12.6	11.8	11.7	12.3	11.8	10.8	13.7	111.9	114.2	114.4
	S.D.	2.62	2.67	2.54	2.65	1.82	2.81	3.46	2.66	2.30	2.36	11.5	14.3	12.1
	Mean Diff.	2.03	2.13	1.75	2.08	1.21	1.51	1.05	0.38	0.90	0.35	11.9	6.4	9.92
	t	3.29	3.75	2.58	3.15	2.60	1.75	1.34	.524	1.45	.570	4.2	1.9	3.4
	p	.01	.001	.05	.01	.05	n.s.	n.s.	n.s.	n.s.	n.s.	.001	n.s.	.01

TABLE XIV

CORRELATIONS BETWEEN SUB-TESTS AND SOCIO-ECONOMIC STATUS AT AGES TEN AND TWELVE

Sub-test	Inf.	Comp	Arith.	Sim.	Vocab.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ	Age level
Edwards	25[a]	26	32	15	35	28	25	15	23	16	36	33	41	ten years
H'head	22	23	31	15	35	25	31	13	30	14	34	34	41	old
Gough	29	26	23	24	29	20	23	14	30	18	37	32	41	
Edwards	42	40	42	35	46	27	27	23	30	25	52	41	52	twelve years
H'head	41	38	37	33	45	27	23	20	34	27	43	31	41	old
Gough	34	35	28	33	41	22	19	18	16	26	43	31	41	

[a]All decimal points have been omitted.

of 30) were significant at or beyond the .05 level of confidence, and all three IQ measures correlated significantly with social status. The mean correlation for verbal sub-tests was .26 and for performance sub-tests the corresponding figure was .22.

At twelve, all the verbal sub-tests correlated with socio-economic status at the .01 level of confidence, although only two out of 15 performance sub-tests correlated with socio-economic status at this level. Nevertheless, statistically significant correlation coefficients were obtained in most cases, at this age level (23 out of 30). The mean verbal sub-test correlation was .38, while the corresponding performance correlation was .25.

From these results, it can be seen that hypothesis 3 is largely supported.

Table XV shows the correlations between the 1961 sub-test scores and the corresponding 1963 scores for the same sub-tests. Thus, these coefficients represent the reliability of the sub-tests over the two-year period.

TABLE XV

SUB-TEST RELIABILITIES OVER A TWO-YEAR PERIOD

Sub-test	Inf	Com	Ari	Sim	Voc	P.C	P.A	B.D	O.A	Cod	VIQ	PIQ	FIQ
$r_{1961.63}$	50[a]	36	34	43	49	45	26	49	24	12	67	58	73

[a]All decimal points have been omitted.

In the case of the verbal sub-tests, all the correlations are significantly different from zero at the .01 level of confidence, but this

is true of only two of the performance sub-tests, and in the case of Coding, the relationship is apparently little better than random. The mean correlation for verbal sub-tests is .43, while for performance sub-tests it is .32.

These results indicate that there are substantial changes in the ranking within the sample over the two-year period, and that these changes tend to be greater in the case of performance than verbal sub-tests. Spearman has pointed out that motor skills are heavily dependent on specific skills rather than 'g', and the low reliabilities of the performance sub-tests are apparently accounted for in terms of development of specific skills, a development which can be expected to occur at different rates in different children.

Factor Analyses

Table XVI shows the correlation coefficients between the 70 1961 sets of sub-test scores. The scaled scores from which they were derived are shown in Appendix B.

These correlations were subjected to factor analysis and the unrotated factor loadings are shown in Table XVII. Also shown in this table are the percentages of the total variance accounted for by each of the factors, and sub-test communalities. Only those factors whose contribution to the total variance was greater than that of a single test were regarded as significant.

Table XVIII shows the rotated factor loadings obtained from the matrix of 1961 correlations. Although rotation produces de-normalized vectors, it permits more meaningful interpretation of factorial structures.

TABLE XVI

CORRELATION MATRIX FOR SUB-TESTS AT AGE TEN

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Inform.	1.00	390[a]	308	393	406	079	237	289	414	133	254	216	291
2. Compr		1.00	247	527	531	258	165	263	197	117	264	234	263
3. Arith			1.00	257	391	069	142	239	281	211	318	309	232
4. Simil				1.00	390	162	146	254	075	014	148	149	243
5. Vocab					1.00	377	314	323	251	306	348	349	293
6. Pic Com						1.00	131	263	270	211	280	249	204
7. Pic Arr							1.00	285	338	182	254	314	227
8. B.D.								1.00	407	009	154	133	139
9. O.A									1.00	240	230	296	301
10. Cod										1.00	160	135	182
11. Edwards											1.00	939	636
12. H'head												1.00	686
13. Gough													1.00

[a]Except in the diagonal, all decimal points have been omitted.

TABLE XVII

UNROTATED FACTOR MATRIX FOR SUB-TESTS AT AGE TEN

Variable	Factors				Commun-ality
	I	II	III	IV	
Information	598[a]	338	059	293	554
Comprehension	600	395	373	-177	686
Arithmetic	534	103	024	073	303
Similarities	494	457	509	000	712
Vocabulary	711	276	053	-304	677
Pic. Compl.	453	047	-218	-510	515
Pic. Arrange.	484	023	-381	231	433
Block Design	478	388	-278	321	559
Obj. Assem.	560	010	-552	266	689
Coding	342	-021	-431	-581	641
Edwards	727	-592	161	027	906
H'head	728	-614	122	077	928
Gough	675	-454	157	077	692
Sum Squares	4.36	1.66	1.23	1.05	8.30
% total variance	33.5	12.8	9.5	8.1	63.9

[a]All decimal points have been omitted.

TABLE XVIII

ROTATED FACTOR MATRIX FOR SUB-TESTS AT AGE TEN

Variable	Factors				Communality
	I	II	III	IV	
Information	529[a]	138	499	-077	554
Comprehension	796	127	069	181	689
Arithmetic	359	253	316	103	303
Similarities	838	067	039	-061	712
Vocabulary	609	195	230	463	677
Pic. Compl.	194	131	106	670	515
Pic. Arrang.	031	202	612	132	433
Block Design	297	046	685	011	599
Obj. Assem.	-039	220	774	202	689
Coding	-025	058	131	787	641
Edwards	134	924	121	139	906
H'head	094	937	167	115	928
Gough	181	792	160	083	692
Sum Squares	2.30	2.61	1.95	1.43	8.30
% total variance	17.7	20.1	15.0	11.0	63.8

[a]All decimal points have been omitted.

Harman (1960), in reviewing mathematical models for rotation, argues that parsimony and ease of interpretation are more basic principles than mathematical purity, and consequently, analytical rotations were carried out.

Four significant factors were obtained. The first two were identified as the general factor and a socio-economic status factor respectively. The third factor loaded particularly highly on Object Assembly, and also Picture Arrangement and Block Design. Consequently, it is identified as a manipulatory/organizational factor. This factor closely resembles Maxwell's Factor II, Cohen's Perceptual Organization Factor, and Gault's Factor II, and is also comparable to Vernon's k:m group factor. It differs from these factors, however, in the high loadings of Information and Arithmetic, which suggest that, in the case of the present sample, a common organizational ability serves verbal and performance material, but that it differs from the verbal reasoning involved in Comprehension and Similarities.

The fourth factor was defined by its loading on Coding, and is probably a memory factor. The high loading of Vocabulary would be consistent with this interpretation. There is a good deal of similarity between this factor and the fourth factor obtained by Gault in his analysis.

At this age level, the unrotated general factor accounted for 33.5 per cent of the variance, and the unrotated socio-economic status factor for 12.8 per cent. After rotation, the general factor variance had dropped to 17.7 per cent and the socio-economic status variance was 20.1 per cent. The very high variance contribution of the socio-economic status factor resulted from the fact that the rotated loadings of the measures of

social status tended to approach unity on this factor.

The rotated socio-economic status factor accounted for 2.8 per cent of the total verbal variance, and 2.2 per cent of the total performance variance.

Table XIX shows the correlation matrix derived from the 1963 scores, the unrotated factor loadings are shown in Table XX, and Table XXI shows the rotated factor loadings. These figures were derived from the scaled scores shown in Appendix C.

At this age level, three significant factors were obtained. Again, a substantial first factor appears, accounting for 41.2 per cent of variance before rotation, and 29.3 per cent of rotated variance. The socio-economic status factor accounted for 12.6 per cent of unrotated variance, and after rotation, this figure had increased to 22.4 per cent.

The rotated socio-economic status factor accounted for 8.3 per cent of the total verbal variance, and 4.0 per cent of the performance variance.

At this age level, the third factor is defined by its loading on Picture Arrangement, and also Picture Completion. Again, it is apparently a perceptual/organizational factor.

Comparison of the 1961 and 1963 factorial patterns indicates that the importance of the general factor contribution to the total variance has increased substantially, apparently at the expense of one of the specific factors, which has disappeared.

The socio-economic status factor has also shown no tendency to disappear, and has actually increased its proportion of verbal variance about threefold (2.8 per cent to 8.3 per cent).

TABLE XIX

CORRELATION MATRIX FOR SUB-TESTS AT AGE TWELVE

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Inform.	1.0	306[a]	592	575	559	382	091	529	397	264	420	410	341
2. Compr.		1.0	399	553	535	286	056	263	267	156	402	380	353
3. Arith.			1.0	618	544	312	211	436	345	234	417	367	279
4. Simil.				1.0	576	360	074	422	298	182	349	329	325
5. Vocab.					1.0	404	253	589	529	170	457	447	412
6. Pic. Com.						1.0	460	341	436	-031	270	268	221
7. Pic. Arr.							1.0	214	243	-008	267	227	187
8. B.D.								1.0	570	215	228	203	176
9. O.A.									1.0	137	298	337	157
10. Coding										1.0	248	272	255
11. Edwards											1.0	939	666
12. H'head												1.0	686
13. Gough													1.0

[a]Except in diagonal, all decimal points have been omitted.

TABLE XX

UNROTATED FACTOR MATRIX FOR SUB-TESTS AT AGE TWELVE

Variable	Factors			Communality
	I	II	III	
Information	735[a]	177	233	626
Comprehension	616	-041	234	436
Arithmetic	716	175	216	590
Similarities	712	191	336	656
Vocabulary	808	197	047	694
Pic. Compl.	556	323	-485	648
Pic. Arrange.	348	011	-746	678
Block Design	630	474	066	626
Object Assembly	606	367	-186	537
Coding	336	-234	397	325
Edwards	739	-560	-159	884
H'head	726	-582	-156	890
Gough	620	-563	-079	708
Sum Squares	5.36	1.64	1.32	8.31
% total variance	41.2	12.6	10.1	63.9

[a]All decimal points have been omitted in factor loadings.

TABLE XXI

ROTATED FACTOR MATRIX FOR SUB-TESTS AT AGE TWELVE

Variable	Factors			
	I	II	III	Communality
Information	746[a]	262	028	626
Comprehension	543	371	-065	436
Arithmetic	724	254	038	590
Similarities	774	229	-069	656
Vocabulary	743	303	225	694
Pic. Comp.	413	097	685	649
Pic. Arrange.	-005	251	784	678
Block Design	754	-026	237	626
Obj. Assembly	586	067	434	537
Coding	288	353	-343	325
Edwards	225	894	184	884
H'head	204	905	174	890
Gough	161	822	080	708
Sum Squares	3.81	2.91	1.58	8.31
% total variance	29.3	22.4	12.1	63.8

[a]All decimal points have been omitted in factor loadings.

The Inter-Battery Factor Analysis

Table XXII shows the covariance matrix from which the inter-battery factor loadings were obtained, and the loadings are shown in Table XXIII. Using Kaiser's criterion for significance of a factor, only factors which contributed more than a single test were obtained. This yielded a single factor, which accounted for 92.1 per cent of the total covariance.

From this, it can be argued that almost all of the intercorrelation between first and second testings was attributable to the general aspect of intelligence, since no specific factors, common to the two administrations of the WISC, were obtained.

Comparison of the various sub-test loadings on the common factor at the two age levels indicates that there is a great deal of consistency in the loadings. This is particularly true in the case of verbal sub-tests.

Only Similarities and Picture Arrangement have made any substantial changes in their loadings, Similarities having increased its loading (.319 to .580) and Picture Arrangement having reduced its loading (.442 to .212).

It should be noticed that no rotations were carried out in the case of inter-battery loadings, since rotation to different criteria would have destroyed the exact equivalence of the two factors.

TABLE XXII

COVARIANCE MATRIX FOR SUB-TEST SCORES AT AGES TEN AND TWELVE

Variable	1	2	3	4	5	6	7	8	9	10
Information	504[a]	357	337	430	489	453	256	487	241	118
Comprehension	344	446	167	326	444	333	039	318	212	040
Arithmetic	591	274	475	388	401	218	045	330	366	330
Similarities	254	319	067	303	257	248	082	076	024	063
Vocabulary	590	495	369	492	613	419	184	434	353	037
Pic. Com.	216	183	214	151	273	288	151	358	282	057
Pic. Arrange.	166	214	164	257	374	341	198	293	291	081
Block Design	445	156	371	369	428	297	068	631	448	032
Obj. Assembly	413	156	295	236	430	273	117	531	513	208
Coding	165	204	101	102	219	-050	-044	199	057	557

[a]All decimal points have been omitted.

TABLE XXIII

SUB-TEST LOADINGS ON THE COMMON FACTOR

Sub-test	Age level	
	Age 10	Age 12
Information	690[a]	714
Comprehension	520	508
Arithmetic	638	501
Similarities	319	580
Vocabulary	771	736
Pic. Completion	403	537
Pic. Arrangement	442	212
Block Design	644	695
Object Assembly	607	539
Coding	250	216

[a]All decimal points have been omitted.

CHAPTER VI

EXPERIMENTAL FINDINGS

The mean differences between scores obtained by high and low socio-economic status groups were significant in the case of almost all verbal sub-tests, at both age levels. Furthermore, the significant differences were almost completely confined to verbal sub-tests. Consequently, hypotheses 1 and 2 were supported by the data. There was a significant tendency for the high socio-economic status portion of this sample to surpass the low socio-economic status children on tests which were dependent on verbal skills sor their solution.

Testing of hypothesis 3 tended to confirm this finding. Significant correlations between socio-economic status and sub-test scores were obtained at both age levels, and these correlations tended to be higher in the case of verbal sub-tests than for performance sub-tests. These results indicate that, as far as the sample employed in this study is concerned, there was a significant relationship between social status and intelligence. The range of correlations obtained (.31 to .52) was consistent with the literature on the subject.

There was a substantial change in the general factor contribution to total variance, at the two testings. Furthermore, a significant factor defined by its high correlation with the measures of socio-economic status was obtained at both testings, and this factor tended to correlate more highly with verbal sub-tests of the WISC, particularly at age twelve. Hence, hypotheses 4 and 5 were supported by the data.

Interbattery factor analysis revealed that the correlation between sub-test scores at successive testings was chiefly accounted for by the degree to which they depended on general intelligence. No common specifics appeared.

The experimental findings may be summarized in the following way.

1. There was a definite relationship between the socio-economic status of the sample of Edmonton school children and their intelligence, as it was measured by the Wechsler Intelligence Scale for Children.

2. An important aspect of this relationship lay in the fact that the children of high socio-economic status scored better on sub-tests involving verbal skills.

3. There was a tendency for the effect of socio-economic status to continue as the children matured.

4. The specific intellectual skills employed by the children changed markedly between the ages of ten and twelve.

CHAPTER VII

IMPLICATIONS OF THE STUDY

The experimental findings have implications in three areas.

The Role of the General Factor in Intelligence

At the age levels employed in this study, previous studies with the WISC have indicated slight reductions in the general factor variance contribution with increasing age of the subjects. Cohen (p. 29) obtained variance percentages of 40 at age $10\frac{1}{2}$ and 36 at $13\frac{1}{2}$, while Maxwell's (p.39) figures for the same age levels were 47.8 per cent and 39.4 per cent, and Gault's (p.41) were 32 per cent and 30 per cent respectively. These findings are also consistent with those of Burt and Garrett. Consequently, the changes observed in general factor variance in this study do not correspond with those obtained in other studies.

This may be partly explained by the fact that the sample employed had had previous experience with the WISC at the second testing, and that they consequently tended to make some use of memory and of a certain familiarity with the scale in attempting the sub-tests. It is also possible that the nature of the educational experiences of the children involved in this study has been such as to foster greater integration, rather than differentiation of abilities.

The Nature of the WISC

There is a strong suggestion in the experimental findings that the WISC measures different skills at the two age levels used in this study.

This supposition is supported by the low reliabilities of the sub-tests, and by the fact that there were no specifics common to the two administrations of the scale.

Furthermore, it is apparent that the scale discriminated quite sharply against the low socio-economic status portion of this sample, and that the tendency of the scale to favour children of high socio-economic status did not disappear with the passage of the two years between testings.

The two matrices of factor loadings make possible some conclusions about the nature of the quantities which the WISC is actually measuring. For this purpose, the socio-economic status factors may be disregarded, since they are an artifact of the particular variables employed in this study. At both age levels, the first factor was verbal rather than performance in nature, and the scale also yielded a further factor predominantly perceptual/manipulatory in nature, at both levels.

Consequently, the WISC scores obtained by the sample employed in this study indicate that a substantial portion of the scale's variance is derived from two dimensions of intellectual functioning, one mainly verbal in nature, and the other chiefly dependent on performance skills. This conclusion, consistent with the findings of Maxwell (p.39), appears to support the reporting of WISC scores in the form usually employed. A factor was identified which may be regarded as corresponding to Verbal IQ, and a further factor which appears to correspond with Performance IQ was also obtained.

Implications for the Classroom

The results of this study indicate that socio-economic status affects

the intellectual performance of Edmonton school children, to a significant degree. When a teacher is considering the relative achievement of his students, he would do well to bear this in mind. Scores on intelligence tests may well poorly reflect the true intellectual potential of the child, since the kinds of skills, and the level of the skills possessed by the child have been shown to be at least partly a function of his social class. Furthermore, differential achievement patterns may reflect social disadvantage.

This study has not indicated the source of social class differences in intellectual functioning. A further relevant study would attempt to measure the relative importance, in discriminating between high and low social groups, of the physical properties of the home as against the class values and attitudes which are brought to bear on life in general and school in particular.

There is a strong suggestion in the experimental findings that the effect of social class does not disappear with maturity. This raises the question of whether socio-economic status should not be recognized by educators as a valid dimension of individual difference, and an attempt made to counteract its effects.

It might be argued that differential training is needed by children from different socio-economic backgrounds. This would seem to be particularly true in the case of verbal skills, especially in view of their central nature in the function of our schools.

Further investigation of the intellectual functioning of this sample, as they continue to mature and develop would be relevant to this question. In many cases, as far as the present study is concerned, trends were observed which were, however, not statistically significant. The

passage of further time might allow these tendencies to develop into statistically significant differences.

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APPENDIX A

THE GOUGH HOME INDEX

S.E. INDEX

1. Name: _____ _____
(Last Name) (First Name)

2. Father's Occupation: _____
(Be clear. For example: Sales clerk at Eaton's, door-to-door salesman for Fuller-Brush, travelling salesman for Massey-Ferguson)

3. Mother's occupation: _____

4. Do you ever use a language other than English in your home? _____

If you do,
(a) Name it here: _____
(b) Circle the words which tell how often you use it:

Hardly Ever Quite Often Most of the time

5. About how long have you lived in Canada? _____

DIRECTIONS: In the following questions, mark your answer by putting a circle in the right place. For example, in the question "Does your family have a car?" draw a circle around the "Yes" if your family does have a car, and around the "No" if it does not. Be sure to answer all the questions.

1. Does your family own a car?- Yes No
2. Does your family have a garage or carport?- - - - - - - - - - - - - - Yes No
3. Did your father go to high school?- - - - - - - - - - - - - - - - - - Yes No
4. Did your mother go to high school?- - - - - - - - - - - - - - - - - - Yes No
5. Did your father go to university?- - - - - - - - - - - - - - - - - - - Yes No
6. Did your mother go to university?- - - - - - - - - - - - - - - - - - - Yes No
7. Is there a writing desk in your home?- - - - - - - - - - - - - - - - - Yes No
8. Does your family have a Hi-Fi or record player?- - - - - - - - - - - - Yes No
9. Does your family have a piano?- Yes No
10. Does your family get a daily newspaper?- - - - - - - - - - - - - - - - Yes No
11. Do you have your own room at home?- - - - - - - - - - - - - - - - - - Yes No
12. Does your family own its home?- Yes No
13. Is there an encyclopedia in your home?- - - - - - - - - - - - - - - - Yes No
14. Does your family have more than 100 hard-cover books?- - - - - - - - - Yes No
(4 shelves about 3 feet long)
15. Did your parents borrow any books from the library in the last year? Yes No
16. Does your family leave town each year for a holiday?- - - - - - - - - Yes No
17. Do you belong to any club where you have to pay fees?- - - - - - - - - Yes No
18. Does your mother belong to any clubs or organizations such as study, church, art or social clubs?- - - - - - - - - - - - - - - - - - Yes No
19. Does your father belong to any such clubs or organizations?- - - - - Yes No
20. Have you ever had lessons in music, dancing, art, swimming, etc., outside of school?- Yes No

APPENDIX B

1961 WISC SCORES

Student	Sub-Test Scores												
	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ
1	15	20	10	19	13	17	15	6	13	3	134	120	130
2	10	14	10	11	11	10	14	15	11	8	108	111	110
3	9	6	11	10	7	8	9	4	10	13	91	92	91
4	13	10	14	15	14	17	11	13	15	14	120	128	126
5	6	10	10	9	11	9	10	7	6	10	95	89	91
6	16	14	13	16	16	14	9	10	9	17	131	113	125
7	10	9	14	11	10	10	8	5	4	8	105	79	92
8	8	10	15	11	12	17	13	12	9	16	108	124	117
9	16	19	13	16	14	19	14	10	11	14	137	125	134
10	17	14	14	15	16	14	20	12	13	9	133	125	132
11	19	18	12	17	12	13	13	19	14	10	135	127	134
12	16	14	13	10	11	15	12	17	15	15	118	133	128
13	15	6	13	14	14	11	12	12	11	16	115	117	117
14	10	11	8	7	11	17	13	12	13	12	96	124	110
15	13	15	14	17	14	17	16	13	13	13	129	131	133
16	9	11	10	13	13	17	11	16	13	11	108	125	117
17	16	17	10	16	13	13	8	7	14	12	128	107	120
18	12	14	14	15	14	15	13	10	14	19	124	129	129
19	13	17	10	14	12	13	12	14	12	16	120	124	124
20	14	14	14	11	12	15	10	13	16	12	119	122	123
21	15	11	7	10	13	15	14	13	14	13	108	127	118
22	15	19	11	17	12	10	11	14	12	11	130	111	123
23	11	15	7	12	10	15	9	11	5	13	106	104	106
24	12	10	15	14	14	9	16	14	10	13	119	117	120
25	11	20	15	16	15	17	11	15	14	13	134	128	134
26	12	11	13	11	12	13	15	12	8	19	111	124	119
27	15	17	14	17	14	18	11	15	8	14	134	122	131
28	14	12	11	15	13	13	13	12	10	13	116	115	119
29	11	12	9	14	14	15	14	14	8	10	113	115	115
30	13	12	9	14	11	9	14	12	7	13	111	107	110
31	9	13	10	10	11	11	11	6	8	14	104	100	102
32	10	17	13	16	13	18	14	10	12	11	124	121	125
33	9	8	11	11	11	15	14	13	14	15	100	129	115
34	13	17	17	15	14	20	15	14	13	17	134	140	140
35	10	12	7	15	11	9	10	7	5	5	106	90	99
36	11	11	15	8	12	15	11	12	9	10	109	110	110
37	18	18	15	16	17	14	13	15	13	18	143	132	141
38	17	5	9	10	7	8	12	9	12	13	97	106	101
39	9	16	11	15	14	11	14	14	9	12	119	114	118
40	14	14	14	13	13	9	12	12	11	12	123	108	117
41	8	10	12	10	11	13	14	12	10	12	101	115	109
42	12	17	9	9	14	13	11	11	8	11	114	106	111
43	17	16	15	17	13	11	10	11	13	9	134	106	123
44	17	16	12	15	14	12	16	13	15	14	130	128	132
45	16	18	15	14	16	14	13	11	10	13	137	115	129
46	10	13	11	15	13	14	11	15	11	9	115	114	116
47	15	17	14	15	12	9	20	9	8	10	129	108	121
48	14	17	17	8	15	9	14	11	17	16	126	124	128

Student	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ
49	12	10	14	10	12	10	13	8	8	16	110	107	109
50	7	11	0	10	10	5	12	8	10	17	96	103	99
51	10	12	11	15	14	9	13	11	12	20	115	121	120
52	11	15	13	16	11	13	14	13	11	15	120	122	123
53	13	17	13	17	13	11	12	13	12	12	129	114	124
54	11	8	6	11	13	15	8	10	5	9	99	96	97
55	10	7	9	11	8	14	14	11	14	7	94	114	104
56	11	17	11	14	12	10	9	10	9	13	119	101	112
57	8	12	9	10	9	11	11	9	11	10	97	103	100
58	12	8	10	7	13	14	10	4	12	17	100	110	105
59	15	12	13	7	14	9	15	18	15	11	114	125	121
60	12	13	13	14	13	15	11	11	10	15	119	117	120
61	10	14	13	13	13	19	11	14	12	13	116	127	123
62	15	15	18	16	13	13	13	16	13	14	134	127	133
63	14	17	11	17	13	8	14	12	10	14	128	111	122
64	13	15	14	14	12	17	11	11	10	20	123	127	127
65	13	18	14	9	12	10	8	6	9	13	120	94	107
66	14	4	13	12	9	9	12	10	12	11	103	106	104
67	12	12	10	11	10	14	7	13	10	10	106	106	107
68	14	17	5	11	13	19	18	13	13	20	113	146	131
69	9	10	9	14	10	9	8	9	5	10	103	87	95
70	14	15	15	16	11	8	9	17	10	11	126	107	119

APPENDIX C

1963 WISC SCORES

Student	Sub-Test Scores													SES Scores		
	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ	Edw	Holl	Gough
1	11	14	10	10	11	12	14	10	8	13	108	110	109	4	12	5
2	12	10	15	16	12	11	14	11	12	14	119	117	120	4	14	10
3	10	10	11	10	9	7	13	10	11	15	100	108	104	5	16	14
4	12	15	15	16	14	13	14	12	14	13	128	122	128	3	12	7
5	9	9	11	7	11	9	14	7	10	11	96	101	99	6	21	12
6	13	15	13	15	14	12	11	11	11	13	125	111	120	5	17	14
7	12	13	11	11	9	9	9	7	7	13	108	93	101	4	15	4
8	13	15	15	15	11	7	9	12	12	17	124	110	119	4	16	14
9	14	20	16	17	17	19	16	14	15	16	143	142	146	1	4	2
10	17	18	19	20	18	19	15	11	13	7	153	121	141	1	4	2
11	13	18	19	19	15	16	14	18	15	13	143	136	144	4	14	6
12	16	13	19	16	15	9	17	18	14	20	137	139	141	1	7	2
13	12	15	13	17	11	14	12	11	8	15	123	114	120	4	15	5
14	11	9	10	11	12	9	10	12	12	13	103	108	106	4	14	11
15	11	15	13	15	15	8	10	14	15	17	124	120	124	1	3	1
16	12	14	13	12	12	8	12	13	11	13	116	110	115	1	6	3
17	11	14	10	11	11	12	13	11	12	15	109	118	115	3	12	8
18	17	13	15	16	14	11	10	10	19	18	131	111	124	2	9	1
19	14	15	9	12	11	16	8	7	13	14	114	111	114	4	13	7
20	17	15	15	16	16	18	13	14	13	14	137	131	137	1	4	3
21	10	10	10	12	12	19	17	13	11	13	105	132	120	6	20	11
22	11	13	11	17	12	9	7	15	9	14	118	106	113	7	20	7
23	7	16	10	11	10	12	12	10	11	14	105	111	109	4	16	6
24	13	14	10	12	15	18	17	17	16	16	118	147	135	4	13	10
25	12	17	13	13	13	18	14	15	15	14	123	136	132	5	18	11
26	9	11	11	10	10	9	7	13	8	13	101	100	101	5	18	12
27	15	15	16	17	12	20	20	13	11	14	131	139	138	3	14	9
28	10	13	15	12	12	13	20	13	6	15	114	124	120	2	10	3
29	15	15	16	18	12	13	10	14	10	13	133	114	126	2	8	9
30	9	13	9	13	11	9	12	10	10	10	106	101	104	4	16	9
31	7	12	11	10	10	5	7	9	7	12	100	86	93	5	17	7
32	13	14	16	18	12	16	14	10	11	16	129	124	129	3	10	5
33	8	14	15	12	12	12	14	12	10	13	114	115	116	5	18	10
34	15	14	15	14	13	18	16	16	16	14	126	142	137	1	3	0
35	18	12	8	13	11	8	14	7	10	9	103	97	100	5	18	13

Student	Sub-Test Scores													SES Scores		
	Inf.	Com.	Ari.	Sim.	Voc.	P.C.	P.A.	B.D.	O.A.	Cod.	VIQ	PIQ	FSIQ	Edw	Holl	Gough
36	13	15	16	17	13	14	9	13	15	16	130	124	130	5	16	11
37	19	17	19	17	16	12	20	17	14	15	148	139	148	3	13	6
38	11	9	12	10	11	14	18	11	9	17	104	127	116	4	15	6
39	13	15	13	16	12	14	14	12	10	12	124	117	123	2	7	5
40	13	15	7	17	12	8	10	12	8	14	118	103	112	4	16	4
41	7	8	11	11	12	16	17	10	15	13	99	123	115	5	17	6
42	8	16	13	12	14	14	16	12	13	10	116	121	120	2	10	8
43	13	13	13	14	12	18	14	10	13	10	119	121	122	3	12	7
44	14	13	13	16	14	18	13	18	14	14	125	138	134	1	4	5
45	17	12	13	13	16	13	16	14	11	14	126	125	128	4	15	88
46	13	10	10	13	11	14	10	10	10	11	109	107	109	5	12	6
47	10	17	15	15	12	18	15	7	9	15	124	120	124	2	10	5
48	15	16	16	17	14	13	12	16	15	17	135	132	137	4	13	8
49	12	14	13	16	13	12	20	12	10	20	123	133	131	2	5	6
50	8	15	11	10	11	8	11	4	8	20	106	101	104	2	5	6
51	13	15	15	18	13	9	12	10	12	15	130	111	123	4	15	5
52	13	11	13	15	14	16	9	13	12	17	120	124	124	3	14	8
53	13	14	10	10	14	12	12	11	10	13	114	111	114	3	12	4
54	13	12	13	14	11	14	12	12	8	11	116	110	115	5	18	11
55	7	10	6	9	9	11	17	11	12	9	89	114	101	6	19	15
56	10	12	15	12	14	12	11	12	8	14	116	110	115	6	20	12
57	9	15	11	10	11	6	10	12	10	10	108	97	103	5	17	8
58	11	15	13	14	12	13	14	11	13	17	119	125	124	4	12	1
59	17	12	16	11	13	13	9	17	18	16	124	132	131	3	10	8
60	10	11	10	10	12	8	16	10	12	13	104	113	109	2	8	4
61	15	8	13	9	10	13	14	14	11	13	106	121	115	4	15	6
62	16	13	15	19	16	14	13	17	17	17	137	139	141	2	9	4
63	13	16	9	13	12	14	11	13	11	19	116	125	123	5	17	6
64	11	15	11	11	13	7	6	11	8	17	114	99	107	3	12	10
65	13	11	13	15	9	13	11	11	9	14	114	111	114	2	12	10
66	11	10	15	11	9	9	8	9	9	14	108	99	104	6	19	11
67	11	15	15	15	14	13	12	13	11	13	125	117	123	2	10	13
68	10	13	0	15	14	14	13	16	11	14	114	125	121	5	18	7
69	8	7	9	10	8	8	11	4	8	13	90	92	90	5	16	10
70	14	13	15	16	13	9	11	12	8	14	126	106	118	6	20	9

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